

REMARKS

Claims 1, 3, 4, 6, 20-26, 30, and 31 are pending in the application. In the Final Office Action of December 9, 2002, the Examiner made the following disposition:

- A.) Objected to claim 1 for an informality.
- B.) Rejected claims 1, 3, 4, 6, 21-23, 25-26, and 30-31 under 35 U.S.C. §103(a) as being unpatentable over *Watanabe et al.*
- C.) Objected to claims 20 and 24.

Applicants respectfully traverse the rejections and addresses the Examiner's disposition as follows:

- A.) Objection to claim 1 for an informality:

Claim 1 has been amended as per the Examiner's request to overcome the objection. Claim 1 has also been amended to clarify that the second embedded diffusion layer is formed as part of the collector of the second vertical type bipolar transistor.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "**VERSION WITH MARKING TO SHOW CHANGES MADE.**

Applicants respectfully submit the rejection has been overcome and request that it be withdrawn.

- B.) Rejection of claims 1, 3, 4, 6, 21-23, 25-26, and 30-31 under 35 U.S.C. §103(a) as being unpatentable over *Watanabe et al.*:

Applicants respectfully disagree with the rejection.

Applicants' independent claim 1, as amended, claims a semiconductor device having a first vertical type bipolar transistor and a second vertical type bipolar transistor having a breakdown voltage that is higher than a breakdown voltage of the first vertical type bipolar transistor. The first vertical type bipolar transistor and the second vertical type bipolar transistor each have an emitter, a base, and a collector. The semiconductor device comprises a substrate and an epitaxial layer formed on the substrate. A first embedded diffusion layer is formed as a part of the collector of the first vertical type bipolar transistor in a first upper part of the substrate and in the epitaxial layer. A second embedded diffusion layer is formed as a part of the collector of the second vertical type bipolar transistor directly on the substrate, in a second upper part of the substrate.

Referring to Applicants' Figure 5 for illustrative purposes, Applicants claim a first embedded diffusion layer 131 formed as part of the collector 135 of the first vertical type bipolar transistor 101, and a second embedded diffusion layer 151 formed as part of the collector 155 of the second vertical type bipolar transistor 102.

This is clearly unlike *Watanabe et al.*, which fails to disclose or suggest a second embedded diffusion layer that is formed as part of a collector of a second vertical type bipolar transistor. Referring to *Watanabe et al.* Figure 8, *Watanabe et al.* discloses two transistors, an NPN transistor 101 and an IIL transistor 201. The IIL transistor 201 has bases 52, collectors 61, injection region 51, and emitter (ground terminal) 610. The IIL transistor 201 is associated with an embedded diffusion region 22". As clearly shown in *Watanabe et al.* Figure 8, the embedded diffusion region 22" is formed as a part of the emitter 610 of the IIL transistor 201, and not as part of the collectors 61. The embedded diffusion region 22" is clearly separated from the collector regions 61 by the bases 52. Therefore, unlike Applicants' claim 1, *Watanabe et al.*'s embedded diffusion region 22" is not formed as part of its collector regions 61. On the other hand, *Watanabe et al.*'s embedded diffusion region 22" is formed as part of its emitter 610, as clearly shown in Figure 8, which fails to disclose or suggest Applicants' claimed embedded diffusion regions.

Therefore, *Watanabe et al.* fails to disclose or even suggest Applicants' claim 1.

Claims 3, 4, 6, 21-23, 25-26, and 30-31 depend directly or indirectly from claim 1 and are therefore allowable for at least the same reasons that claim 1 is allowable.

Applicants respectfully submit that the rejection has been overcome and request that it be withdrawn.

C.) Objection to claims 20 and 24:

Applicants respectfully acknowledge the Examiner's finding of allowable subject matter in claims 20 and 24.

Claim 20 has been amended to be placed in independent form including all of the limitations of its base claim.

Claim 1 is allowable as discussed above. Claim 24 depends directly or indirectly from claim 1 and is therefore allowable for at least the same reasons that claim 1 is allowable.

Applicants respectfully submit the objection to claims 20 and 24 has been overcome and request that it be withdrawn.

CONCLUSION

In view of the foregoing, it is submitted that claims 1, 3, 4, 6, 20-26, and 30-31 are patentable. It is therefore submitted that the application is in condition for allowance. Notice to that effect is respectfully requested.

Respectfully submitted,

 (Reg. No. 45,034)

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

Please amend claims 1 and 20 as follows:

1. (Nine Times Amended) A semiconductor device having a first vertical type bipolar transistor and a second vertical type bipolar transistor having a breakdown voltage that is higher than a breakdown voltage of the first vertical type bipolar transistor, said [transistors] first vertical type bipolar transistor and said second vertical type bipolar transistor each having an emitter, a base, and a collector, the semiconductor device comprising:

a substrate of a first conductive type;

an epitaxial layer formed on the substrate;

a first embedded diffusion layer formed as a part of the collector of the first vertical type bipolar transistor in a first upper part of the substrate and in the epitaxial layer; and

a second embedded diffusion layer formed as a part of the collector of the second vertical type bipolar transistor directly on the substrate, in a second upper part of the substrate, [,

wherein the first embedded diffusion layer is not disposed within the second embedded diffusion layer,

wherein the second embedded diffusion layer is of a second conductive type that is a different conductive type from the first conductive type substrate and includes an impurity concentration that is less than an impurity concentration of the first embedded diffusion layer and is equal to or higher than that of the epitaxial layer, and

wherein a peak position of the impurity concentration of the first embedded diffusion layer resides at a first distance from a surface of the emitter of the first vertical type bipolar transistor and a peak position of the impurity concentration of the second embedded diffusion layer resides at a second distance from a surface of the emitter of the second vertical type bipolar layer such that the first distance is smaller than the second distance.]

20. (Four Times Amended) A semiconductor device [according to claim 1, further] having a first vertical type bipolar transistor and a second vertical type bipolar transistor having a breakdown voltage that is higher than a breakdown voltage of the first vertical type bipolar transistor, said first vertical type bipolar transistor and said second vertical type bipolar transistor each having an emitter, a base, and a collector, the semiconductor device comprising:

a substrate of a first conductive type;

an epitaxial layer formed on the substrate;

a first embedded diffusion layer formed as a part of the collector of the first vertical type bipolar transistor in a first upper part of the substrate and in the epitaxial layer;

a second embedded diffusion layer formed as a part of the collector of the second vertical type bipolar transistor directly on the substrate, in a second upper part of the substrate;

a base layer disposed between two first graft base layers and disposed above the first embedded diffusion layer on the epitaxial layer to define a first epitaxial thickness between the first base layer and the first embedded diffusion layer; and

a second base layer disposed between two second graft base layers and disposed above the second embedded diffusion layer on the epitaxial layer to define a second epitaxial thickness between the second base layer and the second embedded diffusion layer,

wherein the first epitaxial thickness is less than the second epitaxial thickness, and

wherein only the epitaxial layer is disposed between the base layer and the second embedded diffusion layer.



CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited as First Class Mail in an envelope addressed to BOX RCE, Asst. Commissioner for Patents, Washington, D.C. 20231 on March 7, 2003.

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